Roles of religious involvement and social support in the risk of colon cancer among Blacks and Whites.

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Abstract:

This population-based case-control study of Blacks and Whites in North Carolina (1996–2000) examined the relation between social ties, etiology of colon cancer, and stage of disease at diagnosis. Interviews were conducted with 637 cases and 1,043 controls. Information was collected on two dimensions of social ties, structural (network) dimensions and functional (emotional and tangible help) dimensions. Infrequent attendance at religious services (less than once per month) was associated with a regional/advanced stage of colon cancer at diagnosis in Whites (odds ratio (OR) = 1.67, 95% confidence interval (CI): 1.09, 2.57; p for trend = 0.02) but not in Blacks (OR = 1.21, 95% CI: 0.66, 2.21; p for trend = 0.80). Among Blacks, minimal emotional support was strongly associated with risk of colon cancer (OR = 4.62, 95% CI: 2.06, 10.35; p for trend < 0.001) and with both local (OR = 3.69, 95% CI: 1.08, 12.69; p for trend < 0.001) and advanced (OR = 5.10, 95% CI: 2.03, 12.82; p for trend < 0.01) disease. No associations between emotional support and risk of colon cancer or stage of disease were observed among Whites. These results suggest that certain characteristics of social ties are associated with both risk of and prognostic indicators for colon cancer.

Keywords: African americans | colonic neoplasms | religion | social support | Caucasians | north Carolina | public health | epidemology

Article:

Colorectal cancer is one of the most common cancers and is the second leading cause of cancer death in the United States (1). When detected as precursor polyps or in the early stages, colorectal cancer is almost always curable. Blacks have a higher risk of incident colorectal cancer and death than Whites and are more likely to have their disease detected at a later stage (2). The existence of these racial disparities underscores the need to examine factors related to disease risk and prognosis among Blacks and Whites..

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There is a substantial body of evidence linking social ties to health-related outcomes (3). However, most research has focused on structural features (e.g., number and frequency of contacts and membership in religious and other groups) rather than functional features (e.g., emotional or tangible support). "Social networks" may be defined as the system of social ties to which one is connected, and these ties integrate individuals into the larger social structure. Numerous epidemiologic studies have shown that social integration protects against a variety of negative health outcomes, including early mortality (4–7) and poor mental health (8, 9). The evidence regarding physical morbidity is not as strong (4). Furthermore, social integration, including religious involvement, has been positively associated with use of preventive health care services (e.g., cancer screening tests) and engagement in health promotion activities (e.g., physical activity, a healthy diet, abstinence from alcohol and tobacco) (10–14).

These structural measures of social ties are limited, however, in that they assume that all ties are similarly positive. In comparison, functional measures of social support evaluate the positive qualities of social ties. For example, "emotional support" refers to the perception that one is cared for and loved, is esteemed and valued, and can count on others when necessary. "Tangible or instrumental support" refers to help, aid, or assistance with material needs, such as assistance with activities of daily living, finances, or getting to appointments. Importantly, low levels of social integration and/or emotional support have been associated with more advanced stages of disease at diagnosis, all-cause mortality, cancer-related mortality, and poorer survival following a cancer diagnosis (15–17). The unique influence of functional support on particular health outcomes in comparison with structural support deserves further investigation. In the literature, the association between social support and health-related outcomes is weakest and most limited in non-White populations (18, 19) and may differ among racial/ethnic groups (17, 20). Thus, this association between social support measures and health across ethnic groups warrants further investigation.

The particular role of religious involvement in health-related outcomes has been gaining increasing attention. While established measures of social network ties have included variables that assess church group membership in a structural support index (21), there is additional

literature supporting a unique and inverse relation between religious involvement and mortality (22–24). Attendance at religious services increases survival by improving and maintaining good health behaviors, mental health, and social relationships (24). For example, a low frequency of religious attendance has been associated in previous studies with cervical cancer risk (25) and unhealthy lifestyle practices (e.g., smoking and low levels of physical activity) (26). In addition, this literature has described how Blacks may have higher levels of religious involvement than Whites and how associations between religious activity and health may differ across racial/ethnic groups (27). Because few researchers have assessed racial/ethnic similarities and differences with respect to the influence of religious involvement on health-related outcomes, we investigated these associations in the current study.

There are limited data on the relation between structural or functional dimensions of social ties and risk of cancer as a specific health outcome. In the available literature, one study showed an inverse association between religious involvement and cancer risk (25), while several others showed no association between any dimension of social ties and cancer risk (15, 17, 28, 29). Moreover, to our knowledge, no study has focused on the association between social ties and risk of colon cancer. Therefore, our purpose was to examine the relation between social network characteristics, as assessed by well-established measures, and risk of colon cancer among Blacks and Whites in North Carolina. Considering the existing literature discussed here, in the current study we aimed to: 1) determine whether there is an association between well-established measures of social network characteristics and risk of colon cancer and, if so, whether the association differs among Blacks and Whites; 2) contribute further to the literature on social support and health by investigating whether functional measures of social ties are unique predictors of colon cancer outcomes in comparison with structural measures of social support; and 3) determine whether a measure of religiosity is a separable (or unique) protective factor in the association between social ties and colon cancer outcomes.

MATERIALS AND METHODS

Case and control selection

Data for this report were collected as part of the North Carolina Colon Cancer Study, a population-based case-control study conducted in 33 contiguous counties of central and eastern North Carolina. We selected cases and controls using a randomized recruitment strategy to control for potential confounding by race, age, and sex and to achieve a race ratio optimized for statistical efficiency (30, 31). Black cases were oversampled in an attempt to obtain a 1:1 White:Black ratio. Controls were sampled so that the distribution of data on race, age, and

gender matched that of the cases. Because we anticipated that some controls would subsequently prove ineligible, nonlocatable, or nonresident and to allow for nonresponse, we preselected excess numbers of controls.

Cases were identified between October 1, 1996, and September 1, 2000, using a rapid case ascertainment system (32). Eligible participants were between the ages of 40 and 80 years, had pathologically confirmed invasive adenocarcinoma of the colon (International Classification of Diseases, Ninth Revision, code 153), resided in the 33-county study area, and had a North Carolina driver's license or identification card if they were younger than age 65 years. All eligible Black patients were invited to participate. We drew a random sample of White patients of similar age (±5 years) and gender in an attempt to obtain equal numbers of Black and White cases. The response rate (interviewed/eligible) among all colon cancer patients who were eligible and contacted was 72 percent, yielding 637 cases for analysis. Among cases, for responders, the proportions with local, regional, and distant disease were 37 percent, 51 percent, and 10 percent, respectively (2 percent unknown); for nonresponders, the proportions were similar: 32 percent, 51 percent, and 16 percent, respectively (1 percent unknown) ($p = 0.10$).

Population-based controls were selected from two computerized databases: North Carolina Division of Motor Vehicles data for persons under age 65 years and US Health Care Financing Administration files for persons aged 65–80 years. Controls were identified from residents of the 33-county study area. Of the eligible and locatable controls, 62 percent consented to participate, yielding 1,043 controls for analysis.

Data collection

Data were obtained from face-to-face interviews conducted by trained registered nurses. The questionnaire included select information on features of social ties. Information was collected on structural (network) and functional (emotional and tangible) dimensions of social support. Structural aspects of social support were drawn from the Berkman-Syme Social Network Index (21). The measure was developed to assess degree of social integration by assessing four types of social ties: marital status, number of and frequency of contacts with close relatives and friends, church participation, and participation in other organizations (33, 34). A weighted index of intimate contacts is combined with membership in churches and other groups to yield a 12-level index which is then divided into categories: I, low; II, medium; III, medium-high; and IV, high. Level I represents persons with few social ties who can be described as being unmarried, having few friends and relatives, and not being involved in religious or community groups. Level IV represents persons with the most social contacts. The original and adapted Social Network Index

measures have been shown to have predictive validity with regard to risk of cardiovascular disease (33), death (18), and preventive health behaviors (26, 35).

The Social Network Index does not distinguish between church group membership and church attendance. Membership in a religious group is not necessarily an indicator of a high level of religious involvement. Because of the literature on frequency of attendance at religious services and health, we elicited information on frequency of church (or other place of worship) attendance. We evaluated the effect of attendance as a distinct ordinal variable on colon cancer risk and stage of disease at diagnosis.

To measure qualitative and quantitative aspects of functional support, we drew questions from the Yale and Harvard Aging Project questionnaire (36, 37). An index of the availability of emotional support was created through responses (yes or no) to the following items: 1) “Do you currently have a family member or friend to whom you can talk about your health?”; 2) “Do you have anyone else to whom you can talk about your health?”; 3) “Do you have a family member or friend to whom you can talk about your personal problems?”; 4) “Do you have anyone else to whom you can talk about your personal problems?”. By summing these items, we computed a total emotional support score. The availability of tangible support was measured by responses to the following item: “When you need some extra help, can you count on anyone to help you with daily tasks like grocery shopping, house cleaning, cooking, telephoning, or giving you a ride?” (possible responses: yes, no, don’t need help).

Participants were asked whether or not they felt that the social support they received was adequate (36). Adequacy of emotional support was measured with the following item: “Could you have used more emotional support than you received?” Adequacy of tangible support was measured with the following item: “Could you have used more help with daily tasks than you received?” (possible responses: a lot, some, a little, none at all, or received sufficient help). For the colon cancer patients, all questions for measures of social ties were asked in the context of pre-illness support (i.e., support during the year prior to their illness). This was done to minimize the possibility of cases either under- or overreporting more social contacts and support because of their recent cancer diagnosis.

Information on stage at diagnosis was obtained from 592 cases (93 percent). Criteria from the National Cancer Institute’s Surveillance, Epidemiology, and End Results reporting program were used to determine stage of disease (38).

Data analysis

Unconditional logistic regression was used to estimate odds ratios as a measure of the relative risk of colon cancer associated with various aspects of social ties, controlling for suspected colon cancer risk factors and other potential confounders identified in the literature. PROC LOGISTIC in SAS (version 8.0; SAS Institute, Inc., Cary, North Carolina) was used to account for sampling design. Each measure of social ties and an offset reflecting the probabilities used to sample subjects was included to adjust for race, age (as an eight-level ordinal variable that reflected 5-year age categories), and gender. Potential confounders examined in the models included: colorectal cancer in a first-degree relative; educational level; household income; physical activity (metabolic equivalents per week, divided into quartiles); cigarette smoking status; alcohol intake; fat intake; vegetable and fruit intake (servings per day, divided into quartiles); fiber intake (g/day, divided into quartiles); use of aspirin or nonsteroidal antiinflammatory drugs; and body mass index (weight (kg)/height (m)2, divided into quartiles).

Participants with missing values (n = 60) for any of the covariates were not included in the fully adjusted models. Tests for linear trend in the log odds ratio for categories of social ties, when applicable, were conducted by fitting a coefficient to social tie measures. Multiplicative interaction was assessed using first-order cross-product terms for social ties and race/ethnicity. The log-likelihood ratio test was used to determine whether the cross-product term(s) statistically differed from the null. In analyses involving stage of disease at diagnosis, polytomous logistic regression was used to compare each case group simultaneously with the controls (39).

RESULTS

The study population included 1,680 persons (637 cases and 1,043 controls); 724 (43 percent) were Black and 956 (57 percent) were White. The distributions of cases and controls by potential confounders are presented in table 1. Unweighted percentages are reported, representing the sample rather than the underlying population.

TABLE 1.

Characteristics of study subjects, North Carolina Colon Cancer Study, 1996–2000*

	Blacks (*n* = 724)		Whites (*n* = 956)	
	Cases (*n* =	Controls (*n* =	Cases (*n* =	Controls (*n* =

	291)		433)		346)		610)	
	No.	%	No.	%	No.	%	No.	%
Age (years)								
<50	38	13.1	27	6.3	26	7.5	35	5.8
50–64	121	41.6	140	32.7	119	34.4	187	31.0
≥65	132	45.3	261	61.0	201	58.1	382	63.2
Gender								
Male	138	47.4	186	43.0	192	55.5	329	53.9
Female	153	52.6	247	57.0	154	44.5	281	46.1
Educational attainment								
<12 years	126	43.3	191	44.2	96	27.8	121	19.8
High school graduate/GED†	84	28.9	111	25.7	102	29.5	176	28.9
Some college	53	18.2	74	17.1	70	20.2	150	24.6
College graduate	28	9.6	56	13.0	78	22.5	163	26.7
Annual income								
≤$19,999	132	52.4	207	56.6	90	28.2	123	22.4
$20,000–34,999	57	22.6	77	21.0	76	23.8	126	22.9
$35,000–49,999	30	11.9	35	9.6	56	17.6	100	18.2
$50,000–74,999	21	8.3	30	8.2	45	14.1	103	18.8
≥$75,000	12	4.8	17	4.6	52	16.3	97	17.7
Colorectal cancer in a first-degree relative								
No	241	82.8	387	89.6	269	78.0	548	90.6
Yes	50	17.2	45	10.4	76	22.0	57	9.4
Body mass index‡								

≤24.4	67	23.0	97	22.4	115	33.2	170	27.9
>24.4 and ≤27.5	66	22.7	84	19.4	80	23.1	175	28.7
>27.5 and ≤31.4	82	28.2	111	25.6	82	23.7	150	24.6
>31.4	76	26.1	141	32.6	69	20.0	115	18.8
Physical activity (METs†/week)								
≤1,890.0	89	30.6	144	33.3	69	19.9	126	20.7
>1,890.0 and ≤2,053.7	61	21.0	105	24.2	84	24.3	149	24.4
>2,053.7 and ≤2,340.0	63	21.6	81	1837	98	28.3	180	29.5
>2,340.0	78	26.8	103	23.8	95	27.5	155	25.4
Fat intake (g/day)								
≤51.0	63	21.7	113	26.1	67	19.3	148	24.3
>51.0 and ≤68.7	63	21.7	117	27.0	67	19.3	144	23.6
>68.7 and ≤93.1	56	19.2	91	21.0	75	21.7	170	27.9
>93.1	109	37.4	112	25.9	137	39.7	148	24.2
Fruit intake (no. of servings per day)								
≤0.6	98	33.7	125	28.9	130	37.6	181	29.7
>0.6 and ≤1.1	66	22.7	89	20.6	82	23.7	140	22.9
>1.1 and ≤2.0	88	30.2	162	37.4	93	26.9	175	28.7
>2.0	39	13.4	57	13.1	41	11.8	114	18.7
Vegetable intake (no. of servings per day)								
≤1.5	131	45.0	158	3635	88	25.4	124	20.3
>1.5 and ≤2.2	71	24.4	119	27.5	89	25.7	142	23.3
>2.2 and ≤3.0	48	16.5	93	21.5	99	28.6	153	25.1
>3.0	41	14.1	63	14.5	70	20.3	191	31.3

Fiber intake (g/day)								
≤9.6	99	34.0	133	30.7	70	20.2	130	21.3
>9.6 and ≤13.2	89	30.6	115	26.6	106	30.6	143	23.3
>13.2 and ≤17.1	37	12.7	103	23.8	102	29.5	157	25.8
>17.1	66	22.7	82	18.9	68	19.7	180	29.5
Use of aspirin or NSAIDs†								
None	155	54.0	169	39.3	168	48.7	211	35.0
1–15 times per month	74	25.8	139	32.3	73	21.2	185	30.7
≥16 times per month	58	20.2	122	28.4	104	30.1	207	34.3
Cigarette smoking status								
Never smoker	135	46.7	199	46.0	117	33.9	246	40.3
Former smoker	96	33.2	144	33.2	181	52.5	268	43.9
Current smoker	58	20.1	90	20.8	47	13.6	96	15.8
Alcohol use (calories/day)								
None (0)	227	78.3	349	81.0	209	60.8	363	59.6
Lower half (>0–<80)	30	10.3	54	12.5	54	15.7	131	21.5
Upper half (≥80)	33	11.4	28	6.5	81	23.5	115	18.9

* Numbers of cases and controls may not sum to totals because of missing values.

† GED, General Equivalency Diploma; METs, metabolic equivalents; NSAIDs, nonsteroidal antiinflammatory drugs.

‡ Weight (kg)/height $(m)^2$.

The results of a series of logistic regression analyses in which each social tie measure was used separately to predict colon cancer risk, with adjustment for potential confounders, are summarized in table 2. There were no clear differences between cases and controls with respect to the Social Network Index or its component parts other than church group membership. Overall Social Network Index scores were not associated with colon cancer etiology, but some of the individual components of the index were. Not belonging to a church group was modestly

associated with an increased risk of colon cancer in Whites but not in Blacks. However, infrequent (less than once per month) church attendance was modestly associated with risk in Blacks and Whites (p for trend = 0.08). Limited emotional support was associated with increased risk of colon cancer in Blacks and Whites. Although the racial differences were not statistically significant, the magnitude of risk associated with limited emotional support was stronger for Blacks (p for trend < 0.001) than for Whites (p for trend = 0.13; p for interaction = 0.23). Risk of colon cancer was not associated with the availability of tangible support or the adequacy of emotional or tangible support.

TABLE 2.

Odds ratios for invasive colon cancer according to social network measures in Blacks and Whites, North Carolina Colon Cancer Study, 1996–2000*

	Overall				Blacks				Whites			
Social network variable	Cases (*n* = 637)	Controls (*n* = 1,043)	OR†,‡	95% CI†	Cases (*n* = 291)	Controls (*n*= 433)	OR‡	95% CI	Cases (*n*= 346)	Controls (*n*= 610)	OR‡	95% CI
Married/living as married												
Yes	402	686	1.00§		151	227	1.00§		251	459	1.00§	
No	235	357	1.21	0.93, 1.57	140	206	1.30	0.89, 1.90	95	151	1.09	0.74, 1.60
Friends and relatives												
IV (most)	209	345	1.00§		78	120	1.00§		131	225	1.00§	
III	91	143	1.14	0.81, 1.60	37	59	0.98	0.57, 1.72	54	84	1.36	0.87, 2.13
II	192	356	0.81	0.62, 1.06	105	156	1.04	0.68, 1.59	87	200	0.69	0.48, 1.00
I (fewest)	101	129	1.16	0.82, 1.64	56	81	1.04	0.63, 1.72	45	48	1.47	0.86, 2.51
p for trend			0.71				0.83				0.68	
Church group member												
Yes	394	715	1.00§		209	321	1.00§		185	394	1.00§	

No	243	328	1.27	1.00, 1.61	82	112	0.96	0.65, 1.43	161	216	1.47	1.08, 2.01
Other group member												
Yes	314	570	1.00§		130	211	1.00§		184	359	1.00§	
No	323	473	1.03	0.81, 1.31	161	222	1.00	0.69, 1.45	162	251	0.98	0.70, 1.36
Contacts												
III (most)	173	264	1.00§		61	90	1.00§		112	174	1.00§	
II	363	650	0.83	0.64, 1.06	174	262	0.97	0.64, 1.47	189	388	0.77	0.55, 1.07
I (fewest)	101	129	1.06	0.74, 1.52	56	81	0.99	0.58, 1.67	45	48	1.29	0.75, 2.21
p for trend			0.85				0.96				0.95	
Social Network Index												
IV (largest networks)	224	409	1.00§		89	124	1.00§		135	285	1.00§	
III	121	194	1.09	0.80, 1.48	45	72	0.88	0.51, 1.51	76	122	1.35	0.92, 1.99
II	214	350	1.07	0.82, 1.40	121	191	0.94	0.61, 1.43	93	159	1.19	0.82, 1.73
I (smallest networks)	78	90	1.24	0.83, 1.86	36	46	0.98	0.53, 1.81	42	44	1.36	0.77, 2.41
p for trend			0.36				0.92				0.22	
Frequency of church attendance												

Once a week or more	352	612	1.00§		179	277	1.00§		173	335	1.00§	
2–3 times per month	91	161	0.90	0.66, 1.24	55	78	0.97	0.62, 1.52	36	83	0.81	0.50, 1.33
Once a month	27	51	0.95	0.56, 1.62	10	23	0.59	0.25, 1.38	17	28	1.21	0.59, 2.47
Less than once a month/never	167	219	1.31	0.99, 1.73	47	55	1.23	0.75, 2.04	120	164	1.34	0.94, 1.91
p for trend			0.08				0.64				0.08	
Availability of emotional support												
IV (highest)	436	798	1.00§		179	316	1.00§		257	482	1.00§	
III	123	176	1.24	0.93, 1.65	62	77	1.55	1.00, 2.40	61	99	1.02	0.68, 1.53
II	40	43	1.63	1.00, 2.68	24	24	1.83	0.92, 3.61	16	19	1.53	0.70, 3.35
I (lowest)	34	21	3.41	1.83, 6.36	23	13	4.62	2.06, 10.35	11	8	2.20	0.77, 6.30
p for trend			<0.001				<0.001				0.13	
Adequacy of emotional support												
Receives sufficient support	457	750	1.00§		183	261	1.00§		274	489	1.00§	
Needs a little more support	56	86	1.00	0.68, 1.48	32	44	1.12	0.64, 1.95	24	42	0.82	0.46, 1.47
Needs some more support	41	90	0.72	0.47, 1.10	25	55	0.60	0.34, 1.06	16	35	0.77	0.39, 1.53

Needs a lot more support	24	35	1.05	0.59, 1.86	15	24	0.97	0.46, 2.03	9	11	1.47	0.53, 4.06
p for trend			0.89				0.80				0.47	
Availability of tangible support												
Yes	499	787	1.00§		235	343	1.00§		264	444	1.00§	
Does not need help	93	199	0.79	0.59, 1.07	32	65	0.68	0.40, 1.14	61	134	0.82	0.56, 1.19
No	45	57	1.04	0.67, 1.62	24	25	1.21	0.63, 2.33	21	32	0.83	0.43, 1.59
Adequacy of tangible support												
Receives sufficient help	468	732	1.00§		196	276	1.00§		272	456	1.00§	
Needs a little more help	54	116	0.70	0.48, 1.02	25	60	0.65	0.37, 1.15	29	56	0.72	0.42, 1.23
Needs some more help	47	92	0.66	0.44, 0.99	28	46	0.76	0.43, 1.35	19	46	0.59	0.31, 1.10
Needs a lot more help	22	38	0.78	0.43, 1.41	17	23	0.88	0.42, 1.85	5	15	0.42	0.13, 1.35
p for trend			0.82				0.64				0.37	

* Numbers of cases and controls may not sum to totals because of missing values for social tie, sociodemographic, or health behavior variables.

† OR, odds ratio; CI, confidence interval.

‡ Odds ratios and 95% confidence intervals were estimated by unconditional logistic regression, adjusted for race, age, gender, sampling probabilities, family history of colorectal cancer, educational level, household income, physical activity, cigarette smoking status, fat intake, vegetable and fruit intake, fiber intake, use of aspirin or nonsteroidal antiinflammatory drugs, and body mass index.

§ Referent.

To examine the hypothesis that religious involvement and emotional support are associated with colon cancer risk through a behavioral pathway (i.e., social norms acting as a facilitator of screening), we included in the logistic analyses a variable assessing adherence to one of the five options for colorectal cancer screening tests recommended in the American Cancer Society guidelines at the time of data collection (40). For cases, we asked about use of colorectal cancer tests in the context of tests done for screening (i.e., not for symptoms or follow-up of an abnormal test) prior to the appearance of the symptoms related to their cancer diagnosis. The association between church group membership and colon cancer risk in Whites was attenuated after adjustment for recent use of colorectal cancer screening (adherence vs. nonadherence) in the logistic model. Similarly, the estimate of the relative risk for frequency of religious service attendance among Blacks and Whites combined was markedly reduced when the adherence variable was included in the model (OR = 0.94, 95 percent confidence interval: 0.86, 1.04; p for trend = 0.22). Addition of the adherence variable to the models did not markedly change the odds ratios for emotional support.

As is summarized in table 3, not being married or living as married was modestly associated with later stages of disease in Blacks and Whites. No associations with the Social Network Index or its component parts other than church group membership and marital status were observed with stage of disease at diagnosis. Limited religious involvement (attendance at church or other worship services less than once per month or not at all) was modestly associated with a more advanced stage of disease in Whites, but no association was observed in Blacks (p for interaction = 0.44). Limited religious involvement was not associated with local stage of disease in Blacks or Whites. Limited emotional support was strongly associated with local and regional or advanced disease in Blacks; no associations were observed in Whites (p for interaction = 0.27 for local disease and 0.21 for regional or advanced disease). We noted no important differences in the relation of stage at diagnosis with other social tie measures within the population as a whole or by race.

TABLE 3.

Odds ratios for stage of disease at colon cancer diagnosis according to social network measures in Blacks and Whites, North Carolina Colon Cancer Study, 1996–2000

	Local stage						Regional/distant stage					
	Overall		Black		White		Overall		Black		White	
Social network variable	OR*,†	95% CI*	OR†	95% CI	OR†	95% CI	OR†	95% CI	OR†	95% CI	OR†	95% CI
Married/living as married												
Yes	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
No	1.09	0.74, 1.62	1.48	0.82, 2.68	0.82	0.45, 1.49	1.37	1.01, 1.87	1.29	0.83, 2.02	1.38	0.87, 2.20
Friends and relatives												
IV (most)	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
III	0.90	0.52, 1.56	0.89	0.35, 2.25	0.91	0.43, 1.89	0.97	0.64, 1.46	0.82	0.41, 1.64	1.09	0.62, 1.91
II	0.92	0.62, 1.37	1.35	0.69, 2.63	0.83	0.47, 1.45	0.70	0.50, 0.97	0.96	0.57, 1.62	0.56	0.35, 0.90
I (fewest)	1.25	0.74, 2.10	1.20	0.52, 2.76	1.56	0.71, 3.39	1.17	0.77, 1.77	1.10	0.60, 2.01	1.57	0.83, 2.96
p for trend	0.69		0.42		0.75		0.52		0.76		0.50	
Church group member												
Yes	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
No	1.16	0.81, 1.66	1.30	0.70, 2.41	1.11	0.68, 1.80	1.22	0.91, 1.62	0.71	0.43, 1.16	1.61	1.11, 2.38

Other group member												
Yes	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
No	1.08	0.75, 1.55	0.96	0.52, 1.78	1.06	0.64, 1.76	1.07	0.80, 1.44	1.07	0.67, 1.71	0.99	0.66, 1.48
Contacts												
III (most)	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
II	0.79	0.54, 1.16	1.38	0.69, 2.77	0.65	0.39, 1.07	0.75	0.55, 1.01	0.89	0.54, 1.48	0.69	0.46, 1.04
I (fewest)	1.09	0.64, 1.86	1.27	0.53, 3.05	1.24	0.56, 2.71	1.08	0.71, 1.66	1.03	0.55, 1.94	1.43	0.76, 2.72
p for trend	0.96		0.57		0.73		0.78		0.94		0.97	
Social Network Index												
IV (largest networks)	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
III	0.86	0.54, 1.37	1.00	0.42, 2.39	0.99	0.54, 1.81	1.09	0.75, 1.57	0.88	0.45, 1.72	1.37	0.86, 2.21
II	0.87	0.57, 1.32	1.14	0.56, 2.29	0.80	0.44, 1.46	1.10	0.79, 1.52	0.90	0.54, 1.49	1.28	0.81, 2.01
I (smallest networks)	1.22	0.69, 2.16	1.77	0.68, 4.58	1.05	0.47, 2.33	1.28	0.79, 2.09	0.86	0.41, 1.78	1.67	0.83, 3.37
p for trend	0.90		0.31		0.74		0.36		0.65		0.13	
Frequency of church attendance												
Once a week or more	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
2–3 times per month	0.75	0.45, 1.24	1.03	0.50, 2.13	0.50	0.22, 1.12	0.92	0.62, 1.35	0.85	0.49, 1.45	0.94	0.52, 1.73
Once a month	1.06	0.49, 2.30	0.75	0.21, 2.72	0.91	0.31, 2.66	0.85	0.43, 1.67	0.56	0.19, 1.61	1.90	0.47, 3.01

Less than once a month/never	1.17	0.77, 1.79	1.87	0.86, 4.08	0.92	0.53, 1.60	1.41	1.01, 1.98	1.21	0.66, 2.21	1.67	1.09, 2.57
p for trend	0.47		0.19		0.86		0.06		0.80		0.02	
Availability of emotional support												
IV (highest)	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
III	1.18	0.77, 1.83	1.60	0.79, 3.26	0.94	0.51, 1.72	1.20	0.84, 1.70	1.56	0.92, 2.64	0.94	0.57, 1.55
II	2.62	1.40, 4.92	4.39	1.80, 10.71	2.34	0.79, 6.93	1.18	0.62, 2.56	1.12	0.45, 2.78	1.30	0.48, 3.54
I (lowest)	1.86	0.72, 4.78	3.69	1.08, 12.69	0.90	0.14, 5.68	4.23	2.09, 8.60	5.10	2.03, 12.82	2.44	0.70, 8.50
p for trend	0.01		<0.001		0.51		<0.001		<0.01		0.32	
Adequacy of emotional support												
Receives sufficient support	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
Needs a little more support	0.95	0.52, 1.74	0.58	0.22, 1.54	1.03	0.43, 2.46	1.09	0.68, 1.73	1.41	0.72, 2.76	0.87	0.43, 1.77
Needs some more support	0.91	0.47, 1.74	0.73	0.30, 1.76	0.73	0.24, 2.23	0.71	0.42, 1.19	0.49	0.24, 1.01	0.91	0.42, 2.01
Needs a lot more support	1.69	0.77, 3.70	1.99	0.75, 5.29	1.24	0.24, 6.56	0.95	0.46, 1.96	0.68	0.24, 1.90	2.12	0.66, 6.84
p for trend	0.89		0.70		0.47		0.65		0.61		0.85	
Availability of tangible support												
Yes	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
Does not need help	0.84	0.54, 1.31	1.42	0.66, 3.07	0.68	0.38, 1.22	0.75	0.52, 1.08	0.46	0.23, 0.92	0.91	0.58, 1.43
No	0.92	0.47, 1.81	1.28	0.48, 3.39	0.68	0.24, 1.97	1.10	0.65, 1.86	1.31	0.61, 2.85	0.84	0.38, 1.89

Adequacy of tangible support												
Receives sufficient help	1.00‡		1.00‡		1.00‡		1.00‡		1.00‡		1.00‡	
Needs a little more help	0.60	0.32, 1.11	0.50	0.19, 1.30	0.64	0.29, 1.53	0.86	0.55, 1.34	0.89	0.45, 1.74	0.95	0.51, 1.78
Needs some more help	0.62	0.31, 1.20	0.62	0.22, 1.70	0.68	0.25, 1.84	0.83	0.52, 1.33	0.98	0.51, 1.90	0.76	0.36, 1.62
Needs a lot more help	1.06	0.46, 2.41	1.38	0.49, 3.86	0.88	0.17, 4.50	0.58	0.27, 1.28	0.60	0.22, 1.65	0.47	0.12, 1.93
p for trend	0.69		0.77		0.43		0.98		0.48		0.47	

* OR, odds ratio; CI, confidence interval.

† Odds ratios and 95% confidence intervals were estimated by unconditional logistic regression, adjusted for race, age, gender, sampling probabilities, family history of colorectal cancer, educational level, household income, physical activity, cigarette smoking status, fat intake, vegetable and fruit intake, fiber intake, use of aspirin or nonsteroidal antiinflammatory drugs, and body mass index.

‡ Referent.

DISCUSSION

To our knowledge, the present study is one of the few to have investigated associations between social ties, colon cancer risk, and stage of disease at diagnosis. This study included measures of both quantitative and qualitative features of social ties. Evidence presented in this report on Blacks and Whites participating in the North Carolina Colon Cancer Study supports a relation between certain aspects of social relationships and risk of colon cancer. Our study included comparable numbers of Blacks and Whites, thus permitting race-specific analyses.

Consistent with the existing literature, we observed an association between low levels of religious involvement and risk of colon cancer. This association was observed in Whites but not in Blacks. The reason for this is unclear, but it may be due to racial/ethnic differences in religious affiliation or specific religious/spiritual beliefs. If Blacks have a higher level of religious involvement, there may be less variability in these data and therefore a restricted range for testing the association between involvement and colon cancer outcomes in this subgroup (27). Alternatively, the observed association could be due to chance. To better evaluate the mechanisms by which religiosity or spirituality influences health and disease states, future studies should assess religiosity in more detail. These studies should measure the functional aspects of religious involvement, such as how it might benefit self-esteem and coping strategies, as well as associated beliefs, attitudes, and other cultural factors (27).

In this study, limited religious involvement was also related to risk of advanced stages of disease at diagnosis but not local-stage disease. Although we were not able to disaggregate the broad dimensions of religious involvement in the present study, other investigators have done so. For example, available data suggest that public religiousness (attendance at religious services) predicts less death but private religiousness (watching religious television programs or reading scripture) does not confer a mortality benefit (41). As we noted above, the mechanisms by which religious involvement influences risk are not clear. Future studies can assess in more detail functional as well as behavioral dimensions of religious involvement in order to explore these potential mechanisms. We consider two possible mechanisms here. First, studies have shown that religious involvement is associated with lower rates of smoking and excessive alcohol use and with engagement in physical activity (13, 14). In our study, when health behaviors (i.e., diet, physical activity, alcohol use, and smoking) were controlled, we observed an independent relation between church attendance and colon cancer risk. Second, religious involvement has been associated with use of preventive health care services such as cancer screening (13, 42, 43). In our study, associations for the variables measuring religious involvement were attenuated when the variable assessing recent use of colon cancer tests in the context of screening was introduced in the analyses. This supports the hypothesis that the observed relation between religious involvement and colorectal cancer risk is mediated or confounded by screening due to shared variance. However, our data were insufficient to properly address the role of mediating variables, and prospective studies with repeated measures are needed to test the hypothesis that social connections through religious channels may stimulate participation in colorectal cancer screening.

Our study found that the lowest level of perceived availability of emotional support was strongly associated with risk of both local-stage and more advanced-stage colon cancer at diagnosis. The observed associations were stronger in Blacks than in Whites. These findings are similar to those of Reynolds et al. (17), who found that low levels of emotional support were associated with more advanced disease and that the relation was substantially stronger for Blacks. The reason for

the observed racial differences is unclear. Also unclear is the mechanism(s) of how emotional support influences risk of colon cancer. One possibility is that persons who receive emotional support may feel valued and attached; hence, they may take better care of themselves and may avail themselves of preventive services more readily than persons who derive little if any support from others. Members of their social network may provide encouragement and emotional support, expose them to information about health services (e.g., colon cancer screening), and help them obtain access to these services (3). Another possibility is that social support may buffer the effects of life stressors or depression; stressed or depressed persons with low levels of emotional support may not feel as great a sense of self-efficacy or motivation to seek preventive health services (44, 45). Because information on stressful life events and depression was not collected, we were not able to test the stress-buffering hypothesis. Social support has been associated with a greater sense of well-being, lower rates of depression, reduced anxiety, and improved coping (46, 47). These benefits, in turn, may have beneficial effects on the neuroendocrine and immune system (48). This may be an important aspect, since there is biologic evidence that colon cancer risk and progression are mediated by the immune system (49, 50). More needs to be learned about the role of immunologic factors as mediators between psychosocial factors (e.g., stressful life events, social support, and faith factors) and carcinogenesis (51–53).

We did not observe any effects of tangible support on colon cancer risk or stage of disease. One explanation for the null association is that the effects of tangible support may be limited to certain health outcomes (e.g., physical activity or substantial disability) (54). It may also be that tangible support only has effects for certain types of stressors (e.g., coping with poverty or a cancer diagnosis) in terms of a buffering effect.

This study had several strengths. To our knowledge, it was the first study to examine the effects of both structural and functional features of social ties on colon cancer risk in Blacks and Whites. Information was collected on potentially important confounding variables (e.g., age, education, income, physical activity, and diet) so that we could adjust for these factors. Other strengths include the fact that the study was population-based, covered a wide variety of geographic areas, and included a high proportion of Blacks.

Our findings have some limitations. Assessment of data on social ties was retrospective and could have been influenced by a colon cancer diagnosis. Thus, we cannot determine whether limited religious involvement or low levels of social support were antecedent to colon cancer. The possibility exists that physical limitations and psychological stressors imposed by more advanced stages of disease resulted in reduced opportunities for social exchange and erosion of

social support. Information was collected retrospectively in this study, raising the possibility of both random and differential misclassification of data on the social tie variables. To minimize these possibilities, we asked questions eliciting information about social ties among cases in the context of pre-illness social involvement or social support. Furthermore, questions eliciting information on the use of colorectal cancer screening tests specifically were asked in the context of screening tests done prior to the examination in which colon cancer was discovered. The response rates in our study were modest but are comparable to those of many recent population-based studies (55). Nonparticipants (refusers and noncontactable persons) were slightlyyounger than participants and were more likely to be female (amongcases) or male (among controls), but these differences werenot statistically significant (56). As previously discussed, we did not observe differences in stage of disease at diagnosis for participant and nonparticipant cases. We were unable to compare participants and nonparticipants with regard to characteristicsother than age, race, and gender. Thus, selection bias is a potential explanation for ourobserved results.

We controlled for potentially confounding factors; however, there remains a possibility of confounding by other factors, such as neighborhood characteristics, community resources, and psychological and cultural factors. Furthermore, the study found important results for religious involvement; however, this measure was limited in that it only assessed a behavioral dimension of religiosity: attendance at religious services. Measures of how religion functions in individuals' lives and religious beliefs may represent dimensions that influence health-related outcomes more directly (57). The present study is a population-based study that collected a variety of detailed data on colon cancer risk factors as well as social ties.

Future studies should focus assessments on the role of religion in order to assess more comprehensively and precisely how religiosity is linked to colon cancer outcomes. This investigation has provided evidence that limited religious involvement and low levels of social support contribute to the risk of colon cancer. Several questions are raised by these findings, including elucidation of the rationale for variations across racial/ethnic groups and the possible mechanisms through which social connections influence cancer risk and outcomes. We need to learn more about the relative importance of support as a main and/or buffering effect. The observed Black-White differences indicate the need for more research into the social and cultural contexts and meaning of social ties across racial/ethnic groups. As research on social ties and cancer risks and outcomes advances, we will be better able to develop effective theoretically based interventions to encourage use of colorectal cancer screening tests that can prevent the disease or detect it early. Such interventions may have important implications in reducing colorectal cancer risk or changing the course of the disease in some persons.

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